**ORAL ARGUMENT NOT YET SCHEDULED**

No. 24-1087 (and consolidated cases)

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**IN THE UNITED STATES COURT OF APPEALS**
**FOR THE DISTRICT OF COLUMBIA CIRCUIT**

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COMMONWEALTH OF KENTUCKY, ET AL.,
*Petitioners*,

v.

ENVIRONMENTAL PROTECTION AGENCY AND MICHAEL S. REGAN, IN HIS OFFICIAL CAPACITY AS ADMINISTRATOR OF THE U.S. ENVIRONMENTAL PROTECTION AGENCY,
*Respondents*,

ENVIRONMENTAL LAW & POLICY CENTER, ET AL.,
*Intervenors.*

On Petitions for Review of Action of the Environmental Protection Agency,
89 Fed. Reg. 27,842

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# BRIEF OF CLIMATE SCIENTISTS AS *AMICI CURIAE* IN SUPPORT OF RESPONDENTS AND DENIAL OF PETITIONS

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## CERTIFICATE AS TO PARTIES, RULINGS, RELATED CASES, AND SEPARATE BRIEFING

Pursuant to D.C. Circuit Rule 28(a)(1), Amici Climate Scientists Michael Oppenheimer, Noah S. Diffenbaugh, Christopher B. Field, Stephen W. Pacala, Daniel P. Schrag, and Susan Solomon submit the following Certificate as to Parties, Rulings, Related Cases, and Separate Briefing.

All parties and amici appearing before this Court are listed in the Brief for Private Petitioners and in Respondents' Brief, with the exception of Amici Climate Scientists and any other amici in support of Respondents.

References to the rulings under review and to related cases appear in the Respondents' Brief.

Pursuant to D.C. Circuit Rule 29(d), Amici Climate Scientists state that separate briefing is warranted because this brief provides unique, specialized information based on their scientific expertise.

Respectfully submitted,

*/s/ Christophe Courchesne*
Christophe Courchesne
*Counsel for Amici Climate Scientists*

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## GLOSSARY

| | |
|---|---|
| IPCC | Intergovernmental Panel on Climate Change |
| EPA | U.S. Environmental Protection Agency |
| ppm | Parts per million |
| NOAA | U.S. National Oceanic & Atmospheric Administration |
| SPM | Summary for Policymakers |
| WGI | Working Group I |
| SR | Synthesis Report |
| NCA | National Climate Assessment |

## RULE 29 STATEMENTS

Pursuant to Federal Rule of Appellate Procedure 29(a)(4), Amici state that no party or party's counsel authored this brief in whole or in part. No party, party's counsel, or person other than Amici or their counsel contributed money intended to fund preparing or submitting this brief. Pursuant to Federal Rule of Appellate Procedure 29(a)(2) and D.C. Circuit Rule 29(b), Amici have given notice to the Court of their participation because all parties have either consented or indicated no objection.

## IDENTITY AND INTEREST OF AMICI CURIAE

*Amici curiae* are individual climate scientists who have dedicated their careers to studying changes to Earth's climate that have been caused by human activities and the broader effects of those changes.

Amicus **Michael Oppenheimer** is the Albert G. Milbank Professor of Geosciences and International Affairs at Princeton University.[1] He is a long-time participant in the Intergovernmental Panel on Climate Change ("IPCC"), which won the Nobel Peace Prize in 2007. He served most recently as a coordinating lead author on IPCC's Special Report on the Ocean and Cryosphere in a Changing Climate (2019) and as a Review Editor of its Sixth Assessment Report. He has authored over 200 articles published in academic journals and co-authored two books, *Dead Heat: The Race against the Greenhouse Effect*, and *Discerning Experts: The Practices of Scientific Assessment for Environmental Policy*. He is a Heinz Award winner and a Fellow of the American Association for the Advancement of Science.

Amicus **Noah S. Diffenbaugh** is the Kara J Foundation Professor and Kimmelman Family Senior Fellow at Stanford University. He has served as a lead author for the IPCC, and as Editor-in-Chief of the peer review journals

[1] Professor Oppenheimer and his colleagues are appearing in their individual capacities. University affiliations are listed for identification purposes only.

*Geophysical Research Letters* and *Environmental Research: Climate*. He is an elected Fellow of the American Geophysical Union, which has bestowed upon him the James R. Holton Award and the William Kaula Award. He has been recognized as a Kavli Fellow by the U.S. National Academy of Sciences.

Amicus **Christopher B. Field** is the Melvin and Joan Lane Professor for Interdisciplinary Environmental Studies at Stanford University and the Perry L. McCarty Director of the Stanford Woods Institute for the Environment. He co-chaired IPCC's Working Group II from 2008 to 2015, where he led the effort to draft materials on climate change impacts and adaption. He is a member of the U.S. National Academy of Sciences and the American Academy of Arts and Sciences, and a fellow of the American Association for the Advancement of Science, the American Geophysical Union, and the Ecological Society of America. He has received the Max Planck Research Award and the Roger Revelle Medal.

Amicus **Stephen W. Pacala** is the Frederick D. Petrie Professor Emeritus in Ecology and Evolutionary Biology at Princeton University. He has chaired three expert committees for the National Academies of Sciences, Engineering and Medicine related to renewable energy, carbon emissions and mitigation, and the transition to a net-zero carbon economy. He has received numerous honors, including the Weldon Memorial Prize from Oxford University; the Presidential Award from the American Society of Naturalists; an appointment as a Lifetime

Fellow of the Ecological Society of America; and the Robert H. MacArthur Award from the Ecological Society of America. He has been elected as a member of the National Academy of Sciences, the American Association for the Advancement of Science, and the American Academy of Arts and Sciences. He is a member of President Biden's Council of Advisors on Science and Technology.

Amicus **Daniel P. Schrag** is the Sturgis Hooper Professor of Geology, Professor of Environmental Science and Engineering, and Professor of Public Policy at Harvard University. He is the author or co-author of over 180 journal articles, including research on new technological approaches to mitigating future climate change. He was the recipient of the James B. Macelwane Medal from the American Geophysical Union and was named a MacArthur Foundation Fellow in 2000. He has been elected as a member of the American Academy of Arts and Sciences and the American Association for the Advancement of Science.

Amicus **Susan Solomon** is the Lee and Geraldine Martin Professor of Environmental Studies at Massachusetts Institute of Technology. She is particularly well known for having pioneered the theory explaining why the ozone hole occurs in Antarctica and obtaining some of the first chemical measurements that helped to establish the chlorofluorocarbons as its cause. She has authored several influential scientific papers in climate science, including one on the irreversibility of the climate change problem. Among her many awards, she has received the National

Medal of Science (the highest scientific honor in the U.S.), as well as the Grande Medaille (the highest award of the French Academy of Sciences). She is a member of the National Academy of Sciences, the French Academy of Sciences, the Royal Society, the Pontifical Academy of Sciences, and the Acadameia Europaea. She also co-led IPCC's Working Group I. Time magazine named Professor Solomon as one of the 100 most influential people in the world in 2008.

The issues presented in this case are of great importance to Amici because the rulings sought by petitioners to limit EPA's authority to reduce greenhouse gas emissions from the transportation sector would curtail the United States' ability to combat climate change at the federal level at a critical time. It is unequivocal that humanity's greenhouse gas emissions have already fundamentally altered Earth's climate, raising global surface temperature levels by more than 2 degrees Fahrenheit since the late 19th century. While Americans are already feeling the impacts of climate change, regulatory action, including the challenged rules, can still mitigate future danger—assuming EPA retains its longstanding authority to limit greenhouse gas emissions from the transportation and other sectors.

## INTRODUCTION

A decade ago, the Supreme Court recognized that EPA had found "'compelling' evidence" that humanity's greenhouse gas (e.g., carbon dioxide) emissions have changed Earth's climate. *Am. Elec. Power Co. v. Connecticut*, 564 U.S. 410, 417 (2011). At the time, the projected "dangers of greenhouse gas emissions" included "heat-related deaths; coastal inundation and erosion"; "more frequent and intense hurricanes, floods, and other 'extreme weather events'"; and "drought due to reductions in mountain snowpack and shifting precipitation patterns." *Id*.

The perilous future identified in *American Electric* is emerging. Since that ruling, the scientific community has reaffirmed again and again that humanity's actions have rapidly increased Earth's temperature. In the words of the global IPCC, "[h]uman activities, principally through emissions of greenhouse gases, have unequivocally caused global warming, with global surface temperature reaching [2.0 degrees Fahrenheit[2]] above [the] 1850-1900 [temperature] in 2011-2020," and "[g]lobal greenhouse gas emissions have continued to increase." IPCC, CLIMATE CHANGE 2023: SYNTHESIS REPORT 4 (2023) ("IPCC-SR").[3] And the federal government has affirmed that "observed global warming of about 2

[2] Unless otherwise stated, all references to temperature are measured in Fahrenheit.
[3] Hyperlinks to sources appear in the Table of Authorities.

[degrees] over the industrial era is unequivocally caused by greenhouse gas emissions from human activities, with only very small effects from natural sources," with "[a]bout three-quarters of total emissions and warming . . . have occurred since 1970." U.S. GLOB. CHANGE RSCH. PROGRAM, FIFTH NATIONAL CLIMATE ASSESSMENT 1-40 (2023) ("Fifth-NCA"). It is not too late to limit further warming—significant greenhouse gas emissions reductions could keep the total global temperature increase to less than 3.6 degrees. *See* IPCC-SR 10, 12. Without sustained efforts to reduce greenhouse gas emissions, however, the total increase in temperature could be much higher—leading to physical and ecological impacts that would be irreversible for thousands of years, if ever. *Id.*

To put those numbers into perspective, the current 2 degree increase in temperature already has had notable effects across the country. Summer heatwaves and other periods of unusually warm weather are more frequent and more intense, leading to balmy Decembers on the Atlantic Seaboard and temperatures in the Pacific Northwest during the summer of 2021 that were hot enough to cause power cables to sag and roads to buckle. *See infra* p. 15. Climate change has increased total rainfall and extreme flooding in some places; stronger and wetter storms like Hurricanes Harvey caused losses of human life and destroyed billions of dollars of property across the South. *See infra* pp. 18-20. Rising temperatures set the stage for a prolonged drought in the American West, increasing wildfire devastation

across diverse environments, from Montana forestland to the Boulder, Colorado, suburbs. *See infra* pp. 20-21.

If the world remains on a path of high and rising greenhouse gas emissions, the impact of the resulting warming on the American way of life is expected to be far worse. Absent large expenditures on measures to defend the coast, children born this year could see portions of coastal cities like New Orleans, Miami, and Annapolis disappear under a rising ocean. *See infra* pp. 16-17. Such large increases in temperature, and accompanying increases in frequency and/or intensity of extreme weather events and drought could also have severe impacts on the United States' food security, economy, and national defense. *See infra* pp. 25-27. These impacts would continue or accelerate already existing trends, but a dramatic increase in temperature raises the possibility of black swan events that have severe consequences but are difficult to predict—for example, destabilization of parts of the Antarctic or Greenland ice sheets leading to rates of sea level rise several times current most-likely estimates. *See infra* p. 16-17.

These projections are not a counsel of despair. It is still possible to mitigate the human and economic costs of climate change—as particularly relevant here, if greenhouse gas emissions from light- and medium-duty vehicles and other sources are reduced. For more than a decade, in coordination with the automobile industry, EPA has limited the greenhouse gas emissions of the nation's vehicle fleet to help

achieve this goal as that fleet has grown cleaner through the combination of technological innovation and regulatory efforts. Because the challenged rules lawfully and appropriately continue EPA's longstanding regulatory role in reducing greenhouse gas emissions from the transportation sector and will help our society avoid the worst impacts of climate change in the decades to come, Amici respectfully ask this Court to deny the petitions for review.

## ARGUMENT

### I. IT IS UNEQUIVOCAL THAT HUMAN ACTIVITY IS THE CAUSE OF UNPRECEDENTED GLOBAL WARMING.

#### A. The Greenhouse Effect Controls Earth's Temperature, Which Has Been Rising at an Unprecedented Rate.

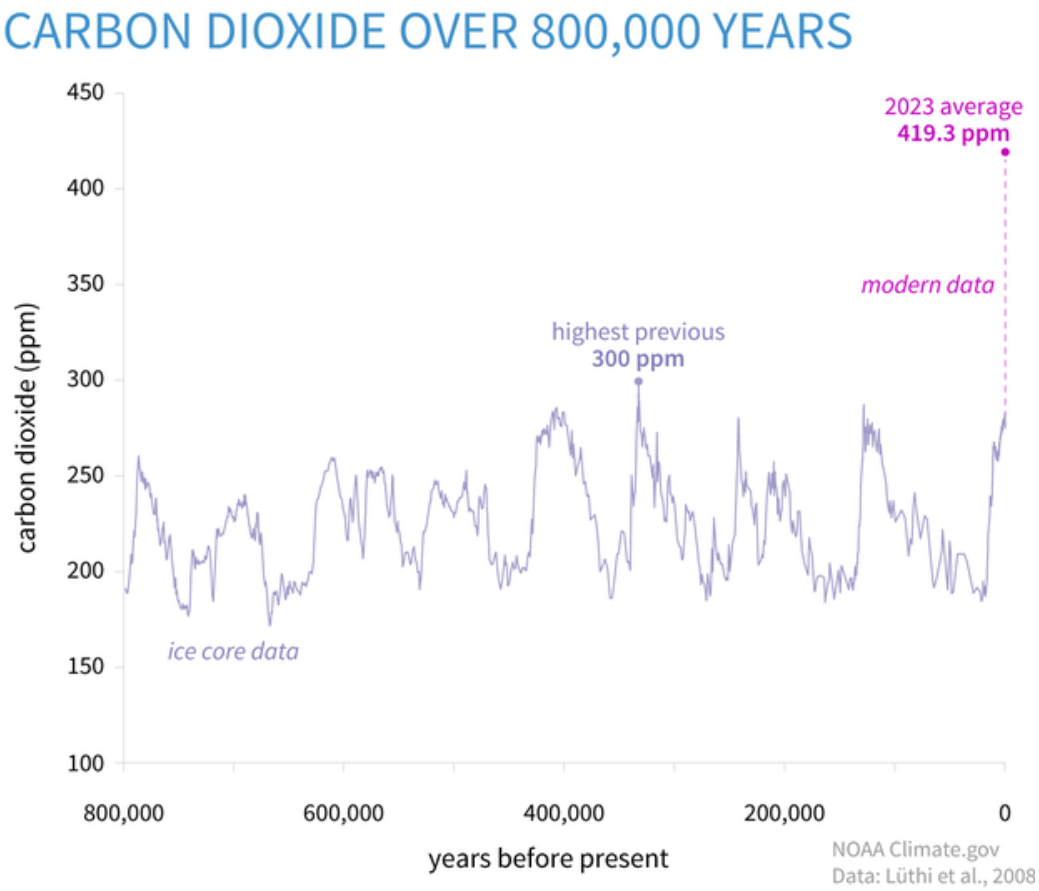
The basic physics of the greenhouse effect are well-established. Earth's atmosphere contains not just nitrogen and the oxygen we breathe, but also greenhouse gases like water vapor, carbon dioxide, methane, and nitrous oxide. *See* Fifth-NCA 1-13. "As their name suggests, when released into the atmosphere, these gases act 'like the ceiling of a greenhouse, trapping solar energy and retarding the escape of reflected heat.'" *Coal. for Responsible Reg., Inc. v. EPA*, 684 F.3d 102, 114 (D.C. Cir. 2012) (quoting *Massachusetts v. EPA*, 549 U.S. 497, 505 (2007)). The resulting "'greenhouse effect … helps keep … Earth warm enough for life.'" *Am. Elec. Power Co.*, 564 U.S. at 416. Indeed, much of the difference in surface temperature between Earth, boiling hot Venus, and icy Mars

can be explained by their respective greenhouse gas levels. *Hearing Before the H. Subcomm. on Env't*, 116th Cong. 3 (2019) (testimony of Dr. Michael Oppenheimer) ("Oppenheimer 2019 Testimony").

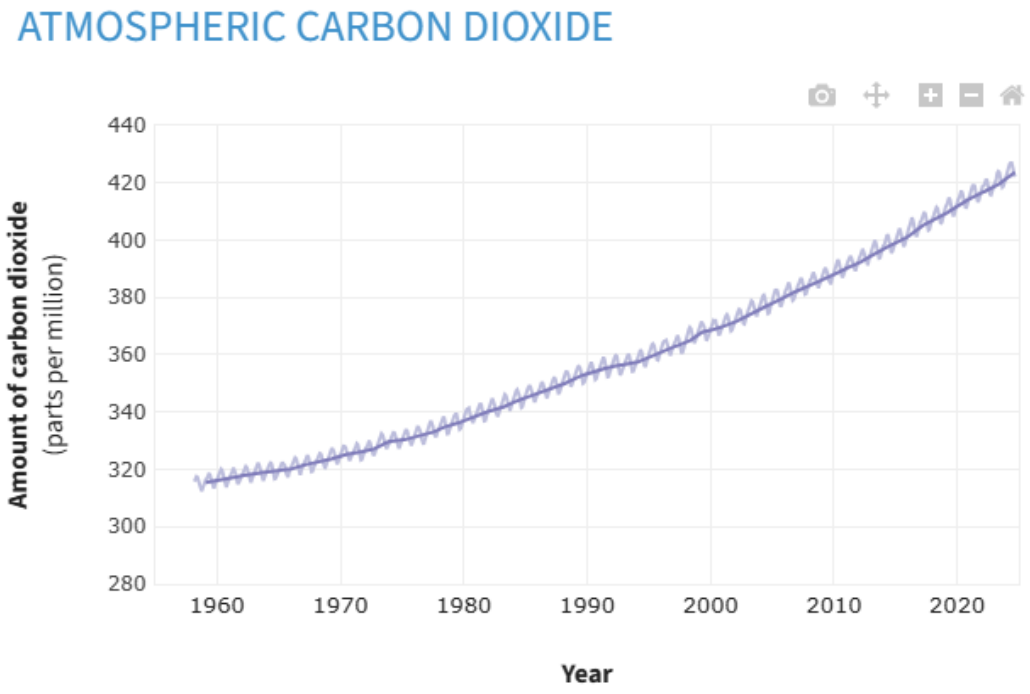
It is similarly well-established that Earth is warming at an unprecedented rate. *See* IPCC-SR 46; *see also* Fifth-NCA 1-17. It can be stated with high confidence that Earth's surface temperature has risen more quickly since 1970 than it has in any other 50-year period since the days of Julius Caesar. Fifth-NCA 1-17 ("Global temperatures have increased faster in the past 50 years than at any time in at least the past 2,000 years."). Further, the last ten years have been the warmest ten years on record since measurements using thermometers began in the mid-1800s. *See 2023 Was the World's Warmest Year on Record, by Far*, NOAA (last updated Jan. 12, 2024).

We can state with high confidence that as temperatures have risen, atmospheric concentrations of greenhouse gases (carbon dioxide, methane, and nitrous oxide) have also increased. Today, these concentrations are higher than they have been in hundreds of thousands of years. IPCC-SR 42. Carbon dioxide alone makes up a higher percentage of the atmosphere than it has in millions of years. *Id.* As the National Oceanic and Atmospheric Administration ("NOAA") charts below demonstrate, the concentration of carbon dioxide in the atmosphere has

skyrocketed in the last sixty years—as is apparent by comparison with the prior 800,000 years.[4]




[4] Both charts can be found at https://tinyurl.com/3rr7xmeu (visited Dec. 6, 2024). The charts' reference to "parts per million" ("ppm") refers to how many parts of carbon dioxide are in one million parts of air. The 2023 value in the first chart is a global average while the second chart is for a single observation station at Mauna Loa, Hawaii, and shows the seasonal variation.




### B. The Only Convincing Explanation for the Rapid Rise in Global Temperature Is That Human Activity Has Altered the Makeup of Earth's Atmosphere.

The observation of both a rapidly heating Earth and skyrocketing levels of carbon dioxide in the modern era is not coincidental. Rather, the evidence is now "unequivocal that human influence has warmed the atmosphere, ocean, and land" and that "[w]idespread and rapid changes in the atmosphere, ocean, … and biosphere have occurred." IPCC-SR 46. Indeed, "global warming observed over the industrial era is unequivocally caused by greenhouse gas emissions from human activities—primarily burning fossil fuels…. No natural processes known to science could have caused this long-term temperature trend. The only credible explanation for the observed warming is human activities." Fifth-NCA 1-13, 2-4.

Specifically, average surface temperatures, both globally and in the United States, updated since IPCC's Sixth Assessment, have increased by more than 2 degrees since the mid-19th century, with three-quarters of that increase occurring in the last 50 years. *See id.* at 1-40; *Climate Change: Global Temperature*, NOAA (updated Jan. 18, 2024); *Climate Change Indicators: U.S. and Global Temperature*, EPA (last updated Jun. 2024) (figs. 1-2). With significant reductions in the emissions of greenhouse gases, it could be possible to limit global temperature increase to less than 3.6 degrees. IPCC-SR 10, 12. Without such reductions, the average global temperature increase could be much higher. *Id.* at 14.

As one of us has summarized, "the broad outlines of [this] problem bearing high risk for humans and society" have been clear for over thirty years, "even if many important details remained to be fleshed out." Oppenheimer 2019 Testimony at 3. By the late 1980s, it was known that (1) "atmospheric carbon dioxide … was increasing and the only plausible explanation was fossil fuel combustion along with a lesser contribution from deforestation," (2) "[c]limate models projected a significant warming due to the increasing greenhouse effect," and (3) "it was … understood that the warming could bring Earth to temperatures not experienced in several million years by the end of the 21st century." *Id.* at 5. These findings led the United Nations—and later the United States, under the leadership of President

George H.W. Bush—to create organizations dedicated to the study of climate change. *Id.* at 5-6 (discussing founding of IPCC); *see also Legal Mandate*, U.S. GLOB. CHANGE RSCH. PROGRAM.

The IPCC has released six major assessments, each providing increasingly compelling evidence that human activity drives climate change. As noted above, the Sixth Assessment—first published in August 2021—concluded that the evidence "unequivocal[ly]" shows that human activity has led to climate change. IPCC-SR 42; *see supra* pp. 8-13. The U.S. Global Change Research Program's reports—which are jointly authored by 13 federal agencies—have affirmed that finding. The most recent, the Fifth National Climate Assessment published in 2023 and cited throughout this brief, stated that "global warming observed over the industrial era is unequivocally caused by greenhouse gas emissions from human activities—primarily burning fossil fuels," and that this is the "only credible explanation." Fifth-NCA 1-13; *see supra* pp. 8-13.

In sum, after decades of study, both the global and American scientific communities have arrived at the same, unequivocal conclusion: Human activity—in particular, the emission of greenhouse gases—has increased Earth's temperature.

## II. CLIMATE CHANGE ALREADY AFFECTS EVERY AMERICAN AND—WITHOUT ACTION—ITS IMPACT ON DAILY LIFE IS EXPECTED TO GROW IN DRAMATIC AND NOT FULLY PREDICTABLE WAYS.

### A. Climate Change Has Already Had Notable Effects Across the Country.

The 2 degree global temperature rise and the consequent "climate change threats, including increases in extreme precipitation, extreme temperatures, sea level rise, and more intense storms, droughts, and wildfires, are"—today—"damaging infrastructure and operations and affecting human lives and livelihoods." Fifth-NCA 5-4.

Between 2016 and 2022, for example, the federal government catalogued over $1 trillion of damages from 122 separate billion-dollar climate and weather disasters in the U.S. *2022 U.S. Billion-Dollar Weather and Climate Disasters in Historical Context*, NOAA (Jan. 10, 2023). Indeed, warmer temperatures in the United States have already been associated with numerous interrelated long-term climate trends, short-term weather events, and resulting impacts, such as (1) extreme heat and heatwaves, (2) rising sea levels, and accompanying coastal flooding, (3) increases in the frequency and intensity of storms producing heavy precipitation, including hurricanes and typhoons, (4) more intense and longer droughts, (5) wildfires, and (6) habitat degradation increasing risk of local extinctions and biodiversity loss.

*Extreme Heat and Heatwaves*: Temperatures across the United States have "warmed rapidly" since the 1970s, and in recent years, "the frequency and intensity of cold extremes have declined over much of the United States while the frequency and intensity of extreme heat have increased." Fifth-NCA 1-16. The federal government estimates that the frequency of heatwaves has increased from two heatwaves per year in the 1960s to more than six per year in the 2020s. *Climate Change Indicators: Heat Waves*, EPA (last updated Jun. 27, 2024). This is no coincidence, as historical warming has made the hottest days of the year globally both more likely and hotter since 1950. *See* IPCC, SIXTH ASSESSMENT WORKING GROUP I REPORT 1534 (2021) ("IPCC-WGI"). For example, the 2021 heatwave in the Pacific Northwest, where temperatures rose 40 degrees above average, hot enough to sag power cables and make asphalt buckle, was more likely and made hotter due to human-caused global warming. Bercos-Hickey et al., *Anthropogenic Contributions to the 2021 Pacific Northwest Heatwave*, 23 GEOPHYSICAL RSCH. LETTERS 1, 1 (2022).

The increasing temperature is especially troubling because "[e]xtreme heat is the leading cause of climate-related death in the" United States. *Hearing Before the Hearing Before H. Comm. on Sci., Space, & Tech.*, 117th Cong. 14 (2021) (testimony of Dr. Michael Oppenheimer) ("Oppenheimer 2021 Testimony"). Higher temperatures are linked to "adverse pregnancy and birth outcomes, mental

health impacts, and increased emergency room visits and hospitalizations related to cardiovascular disease, diabetes, electrolyte imbalance, renal failure, and respiratory outcomes." Fifth-NCA 15-6. And the greatest impacts fall on "children, adults over age 65, those with disabilities, people with mental health or substance-use disorders; and those who are pregnant, lack access to cooling, or engage in outdoor labor and activities." *Id.* From 1991 to 2018, 37% of heat-related summer deaths worldwide were attributable to human-caused climate change. Vicedo-Cabrera et al., *The Burden of Heat-Related Mortality Attributable to Recent Human-Induced Climate Change*, 11 NATURE CLIMATE CHANGE 492, 492 (2021). After decades of decline due to the spread of air conditioning, an analysis of U.S. heat-related mortality between 1999-2023 suggests a substantial upswing beginning in 2016. Howard et al., *Trends of Heat-Related Deaths in the US, 1999-2023*, 332 JAMA 1203, 1203-04 (2024); Barreca et al., *Adapting to Climate Change: The Remarkable Decline in the US Temperature-Mortality Relationship over the Twentieth Century*, 124 J. POL. ECON. 105, 106 (2016).

*Sea Levels and Flooding*: It can be stated with high confidence that global sea levels have risen faster since 1900 than over any prior century in 3,000 years. IPCC, SIXTH ASSESSMENT, WGI, SUMMARY FOR POLICYMAKERS 8 (2021) ("IPCC-SPM"). Rising sea levels are directly linked to climate change. *Id.* The oceans have absorbed most of the heat trapped by greenhouse gases, and they have reacted to

this heat as most liquids do—by expanding and taking up greater volume. *Id.* at 11; Oppenheimer 2021 Testimony at 5-6. At the same time, the ice sheets located around Earth's poles and mountain glaciers are melting at an increasing rate—that meltwater eventually ends up in the ocean. IPCC-SPM 11; Oppenheimer 2021 Testimony at 5-6.

Ocean levels rose 2.7 times faster between 2006-2018 (14.5 inches per century) than they did between 1901-1990 (5.3 inches per century). IPCC-WGI 1289 (Table-9.5). Rising sea levels increased coastal flooding at high tide as much as 5- to 10-fold during 2002-2020 compared to 1950-1968 from Florida to Maine including areas around Jacksonville, Florida; Wilmington, North Carolina; Charleston, South Carolina; Washington, D.C.; and New York City. Sun et al., *Causes of Accelerated High-Tide Flooding in the U.S. Since 1950*, 6 NPJ CLIMATE & ATMOSPHERIC SCI. 1, 2 (2023).

*Storms and Hurricanes*: As to rain and snow storms, "[t]he frequency and intensity of heavy precipitation events have increased across much of the United States." Fifth-NCA 2-19. This result is consistent with higher temperatures leading to more water vapor in the atmosphere, which result in more frequent and intense precipitation extremes. *See id.* 3-21. Storm-caused flooding inflicts billions of dollars in damage annually in the United States, and research suggests that intensifying precipitation has been responsible for about a third of those costs in

recent years. Davenport & Diffenbaugh et al., *Contribution of Historical Precipitation Change to US Flood Damages*, 118 PNAS 1, 3 (2021). For example, the exceptionally heavy precipitation and flooding events that occurred in the mid-Atlantic states including Pennsylvania, New Jersey, Maryland, and Washington, D.C. in 2018 were made 1.1 to 2.3 times more likely by human-caused climate change. Winter et al., *Anthropogenic Impacts on the Exceptional Precipitation of 2018 in the Mid-Atlantic United States*, 101 BULL. AM. METEOROLOGICAL SOC'Y 5, 5 (2020); *see also* Kirchmeier-Young & Zhang, *Human Influence Has Intensified Extreme Precipitation in North America*, 117 PNAS 13308 (2020).

Notably, the increase in intense rainstorms combined with sea level rise has made hurricane season in the north Atlantic Ocean more dangerous. Fifth-NCA 2-20, 9-23. While climate change may not increase the total number of hurricanes, hurricanes' precipitation totals are expected to rise. Unusually high precipitation totals have been observed and directly linked to climate change in some recent hurricanes. For example, climate change was estimated to have increased the rainfall of Hurricane Harvey—a storm that made landfall in Texas and Louisiana in 2017—by about 15% to 20%, "which increased the flooded area . . . by 14%, leading to 32% more homes being flooded." *Id.* 4-21. Human-caused warming has fueled increased overall intensity and rainfall totals of other recent hurricanes as well. Reed et al., *Attribution of 2020 Hurricane Season Extreme Rainfall to*

*Human-Induced Climate Change*, 13 NAT. COMMC'NS. 1, 2 (2022) (citing evidence for Hurricanes Irma, Maria, Florence, and Dorian and entire 2020 North Atlantic hurricane season); Gilford, et al., *Human-Caused Ocean Warming Has Intensified Recent Hurricanes*, 3 ENV'T. RSCH.: CLIMATE 1, 1 (2024) (finding higher wind speeds for North Atlantic hurricanes between 2019-2023). And higher sea levels, along with storm surges, have further increased the risk of coastal flooding. Trenberth et al., *Hurricane Harvey Links to Ocean Heat Content and Climate Change Adaption*, 6 EARTH'S FUTURE 730, 741-42 (2018) (using Hurricane Harvey to demonstrate how human-induced climate change causes higher sea temperature, intensifies storms, and increases flooding rains); Lin et al., *Hurricane Sandy's Flood Frequency Increasing From Year 1800 to 2100*, 113 PNAS 12071, 12071-73 (2016) (frequency of Hurricane Sandy-like extreme flood events has increased significantly over past two centuries due to compound effects of sea level rise and storm surge and are projected to increase more sharply over this century).

The results were catastrophic. The 2017 Atlantic hurricane season alone caused more than 250 deaths and $250 billion in damage. U.S. GLOB. CHANGE PROGRAM, FOURTH NATIONAL CLIMATE ASSESSMENT 66 (2017) ("Fourth-NCA"). Hurricane Harvey's total rainfall in Houston and surrounding areas "likely exceed[ed] that of any known historical storm in the continental United States." *Id.* at 66, 95-96. The storm killed 68 people and inflicted $125 billion in damage.

NOAA, SERVICE ASSESSMENT: AUGUST/SEPTEMBER 2017 HURRICANE HARVEY iv (June 2018).

*Droughts*: In addition to intensifying precipitation, rising global temperatures increase the intensity, frequency, and duration of droughts and "are already amplifying drought severity in California, the Pacific Northwest, the Colorado Basin, and across southwestern North America," Fifth-NCA 3-32; *see also id.* at 2-25. It can be said with medium confidence that "human-induced climate change" has made droughts worse by increasing the rate at which water evaporates into the atmosphere. IPCC-SPM 8; *see also id.* at 24 (as temperatures increase in future, "the level of confidence in and the magnitude of the change in droughts … increase").

Drought and related conditions in recent years have caused billions of dollars in damage in the western United States. Fifth-NCA F1-4 (citing, e.g., economic damages of $38.5 billion from 2020-2021 heat, drought, and wildfires across the western U.S.). California's 2021 drought alone "cost California farming sectors an estimated $1.28 billion (in 2022 dollars)" and "the loss of 8,745 full- or part-time jobs." *Id.* 28-19.

*Wildfires*: Climate change also plays a role in wildfires—higher temperatures dry out vegetation and make forests more likely to burn. *Id.* 3-32. Fire weather is increasing in the western United States, and human-caused

warming is the main cause of that increase. Zhuang et al., *Quantifying Contributions of Natural Variability and Anthropogenic Forcings on Increased Fire Weather Risk Over the Western United States*, 118 PNAS 1, 7 (2021); *see also* Diffenbaugh et al., *Atmospheric Variability Contributes to Increasing Wildfire Weather but Not as Much as Global Warming*, 118 PNAS 1, 1 (2021) . During the summer of 2015 alone, "over 10.1 million acres—an area larger than the entire state of Maryland—burned across the United States." Fourth-NCA 67-68. The scope of the wildfires in that year was unprecedented since recordkeeping began in 1960, burning over 5 million acres in Alaska and 1 million in Montana. *Id.* In both 2017 and 2020, more than 10 million acres across the United States were burned each year. HOOVER & HANSON, CONG. RSCH. SERV., IF10244, Wildfire Statistics (2021).

Climate change exacerbates "extreme fire behavior," as climate change causes "higher temperatures and drier conditions that prime the landscape for fires to catch and spread more easily." Synolakis & Karagiannis, *Wildfire Risk Management in the Era of Climate Change*, 3 PNAS NEXUS 151, 151 (2024). In a recent example, on August 8, 2023, the devastating wildfire in Maui, Hawaii, caused 102 deaths and became "the deadliest U.S. wildfire in more than a century." *Id*. at 152; *Death Toll of Maui Wildfire Now at 102*, N.Y. TIMES (Aug. 9, 2024).

*Loss of Biodiversity*: Increases in temperature affect not just the land and seas, but the creatures that inhabit them. Because species ranges and rates of reproduction and survival are often strongly affected by climate, climate change disrupts natural ecosystems. Fifth-NCA 1-31. For example, tree-killing bark beetles have dramatically expanded their ranges in both the eastern and western United States. *Id.* 7-13. In the Mississippi River Basin—the home of over 300 fish species, as well as waterfowl, turkey, moose, and alligator—more frequent hot days and milder winters have begun to disrupt wildlife mating and migration patterns. NAT'L WILDLIFE FED'N, HUNTER'S & ANGLER'S GUIDE TO CLIMATE CHANGE 8-9 (2021).

In some cases, climate change has thinned species' populations and contributed to local extinction. *See* Wiens, *Climate-Related Local Extinctions are Already Widespread Among Plant and Animal Species*, 14 PLOS BIOLOGY 1, 1 (2016) ("[C]limate-related local extinctions have already occurred in … 47% of the 976 species surveyed" and "will presumably become much more prevalent as global warming increases"); Panetta et al., *Climate Warming Drives Local Extinction: Evidence from Observation and Experimentation*, 4 SCI. ADVANCES 1, 1 (2018) ( "local warming is driving local extinction").

The loss of biodiversity is not limited to land. Oceans are warming, *see supra* pp. 16-17, and "[i]t is virtually certain that human-caused [carbon dioxide]

emissions are the main driver" of ocean acidification. IPCC-SPM 5. Acidification causes a marked decrease in carbonate ions—the building blocks of coral and sea shells. *See* Fifth-NCA 1-31. The United States' major coral reefs are thus both dying (from the increased water temperatures, among other contributors to decline) and unable to rebuild (due to acidification). *Id.* 1-31, 8-16.

Further north, the shellfish inhabiting the Gulf of Maine are also vulnerable to warming and ocean acidification, reducing the ability of Mainers to catch or raise shellfish like lobsters, scallops, blue crabs, and oysters. *See id.* 21-10. And on the other side of the country, salmon populations have declined for decades and now face extinction due to the warming climate. Crozier et al., *Climate Change Threatens Chinook Salmon Throughout Their Life Cycle*, 4 COMMS. BIOLOGY 1, 3, 5 (2021).

### B. Absent Action, More Severe Consequences Are Expected.

Under any realistic emissions scenario, global surface temperature will continue to increase until at least 2050. IPCC-SPM 14. If greenhouse gas emissions can be significantly reduced, warming could be limited to less than 3.6 degrees since the late 19th century. IPCC-SR 10. Absent sustained efforts to reduce greenhouse gas emissions, the total increase in temperature could be far greater. *Id.*

Without rapid reductions in greenhouse gas emissions, "the risks of extreme weather, compound events, and other climate impacts will continue to grow,"

Fifth-NCA 2-33, including physical and ecological impacts that are essentially permanent. *See* IPCC-SPM 21 (changes to ocean temperature and acidification—as well as to permafrost—"are irreversible for centuries to millennia").

Listing all potential harms that could occur in the next twenty-five to seventy-five years as a result of climate change would require hundreds of pages. *See, e.g.*, Fifth-NCA chs. 4-30. We have included representative examples below.[5]

*Coastal Cities And Landmarks Flooded*: Even under a low emissions scenario, oceans will rise approximately 7-13 inches by midcentury and approximately 11-23 inches in eighty years. Oppenheimer 2021 Testimony at 7; Oppenheimer et al., *Sea Level Rise and Implications for Low-Lying Islands, Coasts, and Communities*, *in* IPCC SPECIAL REPORT ON THE OCEAN AND CRYOSPHERE IN A CHANGING CLIMATE 321, 327 (2019) ("*Sea Level Rise*"). In practical terms, by 2050, water levels during storms and very high tides, previously only seen once a century, are expected annually in places like Savannah, Jacksonville, Miami, and San Diego. Oppenheimer 2021 Testimony at 9; *see also* Fifth-NCA 21-8. Without reductions in greenhouse gas emissions, ocean levels will continue increasing, as much as approximately 9-16 inches by midcentury and

[5] The extent of climate change harms depends on actual greenhouse gas emissions, and scientists rely on different emission scenarios including very high emissions scenarios to assess potential impacts, as referenced in the cited sources.

approximately 24-43 inches by 2100. Oppenheimer 2021 Testimony at 7; *Sea Level Rise*, *supra*.

*Food Security At Risk*: Around the world, "[c]limate change has already affected food security due to warming, changing precipitation patterns, and greater frequency of some extreme events." IPCC, CLIMATE CHANGE AND LAND, SUMMARY FOR POLICYMAKERS 10 (2020). In the United States, warming and related precipitation and moisture changes may decrease the agricultural yields of commodity crops, including corn, soybeans, and cotton, by 63-82% under a very high emissions scenario by the end of the century. Fifth-NCA 19-8; *see also id.*11-24, 22-31; *Global Climate Change Impact on Crops Expected Within 10 Years, NASA Study Finds*, NASA (Nov. 2, 2021) (under high emissions scenario, corn yields are projected to decline 24% by 2030).

*Heat-Related Health Issues Spread*: Rising heat poses an increasing threat to human health. For example, in a world of very high emissions, "almost three-quarters of the world's population" will live in areas that are exposed to deadly levels of heat and humidity for at least 20 days a year by 2100. Mora et al., *Global Risk of Deadly Heat*, 7 NATURE CLIMATE CHANGE 501, 505 (2017). And this is not a risk that is decades away. In 2024, Phoenix set a record of 113 consecutive days

above 100 degrees.[6] And in May 2024, India experienced a record temperature of 126 degrees, shattering the previous record of 120 degrees.[7]

In North America, climate change is projected to shift the geographic range and distribution of disease-carrying insects and pests, exposing more people to ticks that carry Lyme disease and mosquitos that transmit viruses such as West Nile, dengue, Zika, and chikungunya. Fifth-NCA 15-8. Moreover, "increases in air temperature will impact water quality by increasing water temperatures, resulting in less oxygen-rich water, exacerbating harmful algal blooms, increasing pathogens, and creating problems with drinking water taste and odor." *Id.* 4-31.

*Damage to National Economy*: Other harms wrought by climate change could cost the U.S. economy trillions of dollars, with projected damage to coastal property from sea level rise alone of at least $550 billion and annual flooding losses potentially rising 60% by 2050. *Id.* 19-8 to 19-9. For workers, if global greenhouse gas emissions are not reduced, lost wages due to unsafe heat in the U.S. could range from $19.2 billion to $46 billion per year (in 2022 dollars) by midcentury. *Id.* 15-12. By that time, cumulative costs to U.S. consumers of electric

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[6] *Heat Wave in Southern California and the Southwest in Early September 2024*, CLIMATE.GOV (Sept. 13, 2024)

[7] *Delhi's Hottest Day Ever: Mercury Level Reaches 52.3 Degrees Today; Record-Breaking, Highest Temperature in History*, TIMES OF INDIA, May 29, 2024.

power interruptions from extreme weather and heat could reach $6.8 trillion dollars. *Id.* 19-9.

*National Security At Risk*: Rising temperatures and intensifying storms due to climate change also threaten the United States' national security. The Department of Defense has recognized for a decade that "global climate change will have wide-ranging implications for U.S. national security interests." U.S. DEP'T OF DEF., THE NATIONAL SECURITY IMPLICATIONS OF CLIMATE-RELATED RISKS AND A CHANGING CLIMATE 2 (2015); *see also* U.S. DEP'T OF DEF., CLIMATE RISK ANALYSIS 4 (2021) ("Climate Risk Analysis") ("Climate change touches most of what th[e] Department does, and this threat will continue to have worsening implications for U.S. national security."); Fifth-NCA 17-8. To take one example, "coastal erosion, degrading permafrost, wildfire, and other climate effects" threaten the many strategically-significant U.S. military installations in Alaska. Fifth-NCA 29-30. More broadly, "[c]limate change impacts and responses can contribute to political and social instability as well as various forms of conflict." *Id.* 17-8. Indeed, "in worst-case scenarios[,] climate-change related impacts could … contribute to mass migration events or political crises, civil unrest, shifts in the regional balance of power, or even state failure." Climate Risk Analysis at 8.

*Some of the Most Extreme Outcomes Are Unpredictable*: It can be stated with high confidence that the probability of (currently) "low-likelihood, high-

impact outcomes increases with higher global warming levels." IPCC-SPM 27; *accord* Fifth-NCA 2-31 to 2-33. For instance, "[h]uman influence has likely increased the chance of" multiple climate-change-related impacts occurring at the same time, like "concurrent heatwaves and droughts" or extreme rainfall combined with coastal flooding. IPCC-SPM 9 (emphasis omitted). So-called "compound events" have "cascading impacts that cause greater harm than individual events." Fifth-NCA 1-18. For example, in 2020, across California, Oregon, and Washington, "record-breaking heat and widespread drought contributed to concurrent destructive wildfires . . . exposing millions to health hazards and straining firefighting resources." *Id.* 1-18. And in 2021, "[o]ngoing drought amplified the record-breaking Pacific Northwest heatwave of June 2021, which was made 2 [degrees] to 4 [degrees] hotter by climate change," leading to "more than 1,400 heat-related deaths, another severe wildfire season, mass die-offs of fishery species important to the region's economy and Indigenous communities, and total damages exceeding $38.5 billion." *Id.* 1-18 to 1-19.

Higher temperatures and their effects also increase the likelihood of large-scale shifts in the climate system. *Id.* 2-31; *see also* IPCC-SPM 27 ("with higher global warming levels," "[a]brupt responses and tipping points of the climate system … cannot be ruled out"). For example, it can be projected with high confidence that—over the next eighty years—water from increased rainfall and

melting ice will weaken the Atlantic Ocean currents that move warm water north and cold water south. IPCC-SPM 27; *see also* Fifth-NCA 2-32. While it can be said with medium confidence that the currents will not collapse during this century, "[i]f such a collapse were to occur, it would very likely cause abrupt shifts in regional weather patterns and water cycles"—e.g., shifting rain events further south and away from Europe. IPCC-SPM 27 (emphasis omitted). As another example, warming temperatures in the Arctic could release substantial amounts of carbon dioxide and methane trapped in the permafrost, which contains "roughly double the amount [of carbon] in the atmosphere," and the ocean floor, driving continued warming even if human-caused emissions stopped. Fifth-NCA 2-31.

## III. THE UNITED STATES STILL HAS THE OPPORTUNITY TO HELP MITIGATE THE EFFECTS OF CLIMATE CHANGE.

While we cannot avoid all negative effects from climate change, it is not too late to limit the harm. Indeed, "[t]he faster and further the world cuts greenhouse gas emissions, the more future warming will be avoided, increasing the chances of limiting or avoiding harmful impacts to current and future generations." Fifth-NCA 1-37.

The transportation sector provides an enormous opportunity for emission reduction, as it is now the largest U.S. source of greenhouse gas emissions, generating 29 percent of total emissions. EPA, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990-2022 2-4 (2024). EPA's rules properly rest on

feasible and available technological innovations, including efficient electric vehicles with no tailpipe greenhouse gas emissions, that are essential to reduce transportation emissions consistent with the urgent need for substantial reductions.

As the nation with the second-highest emissions of greenhouse gas emissions in the world (and higher than the largest emitter, China, on both cumulative and per capita bases), GLOBAL CARBON PROJECT, GLOBAL CARBON BUDGET 2024 24-25 (2024), the policies that the United States sets into place, including this rule, can make a substantial difference in the conditions that future generations will face. *See* IPCC-SPM 28 (noting "with high confidence … that there is a near-linear relationship" between carbon dioxide emissions and global warming); Fifth-NCA 2-33 ("How much more the world warms depends on the choices societies make today. The future is in human hands."). Eliminating most transportation emissions—this rule alone is projected to reduce carbon dioxide emissions by a cumulative total of approximately 7.2 billion metric tons[8]—could avoid 200,000 to 2,000,000 deaths by 2050, including from the related reductions in dangerous conventional air pollution. Fifth-NCA 32-26. In the United States, "the benefits of deep emission cuts for current and future generations are expected to far outweigh the costs." *Id.* 1-5. Moreover, investments in clean fuels and electrification of transportation have the potential to position these technologies as

[8] 89 Fed. Reg. 27842, 28095 (Apr. 18, 2024).

optimal choices for the rest of the world, greatly amplifying the impact of U.S. policies. This Court should not limit EPA's ability to enact rules for the transportation sector that are responsive to this reality and will help protect the future for today's and tomorrow's children.

## CONCLUSION

For the foregoing reasons, Amici Climate Scientists ask this Court to deny the petitions for review.

Respectfully submitted,

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## CERTIFICATE OF COMPLIANCE

I hereby certify that this brief complies with the type-volume limitation of Fed. R. App. P. 29(a)(5) because it contains 6,472 words, excluding the parts of the brief exempted by Fed. R. App. P. 32(f) and D.C. Cir. R. 32(e)(1).

This brief complies with the typeface requirements of Fed. R. App. P. 32(a)(5) and the type style requirements of Fed. R. App. P. 32(a)(6) because it has been prepared in a proportionally spaced 14-point roman-style typeface (Times New Roman) using Microsoft Word.

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## CERTIFICATE OF SERVICE

I hereby certify that, on December 6, 2024, I electronically filed the foregoing with the Clerk of the Court for the United States Court of Appeals for the District of Columbia Circuit using the appellate CM/ECF system, which served a copy of the document on all counsel of record in the case.

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